Travel-Associated Illness in Older Adults (>60 y) for the GeoSentinel Surveillance Network See Appendix 1 for members of the GeoSentinel Surveillance Network

Philippe Gautret, Jean Gaudart, Karin Leder, Eli Schwartz, Francesco Castelli, Lian Lim, Holly Murphy, Jay Keystone, Jacob Cramer, Marc Shaw, et al.

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Travel-Associated Illness in Older Adults (>60 y)

Philippe Gautret, MD, PhD,[*] Jean Gaudart, MD, PhD,[†] Karin Leder, MD, PhD,[‡§] Eli Schwartz, MD,[‖] Francesco Castelli, MD, PhD,[¶] Poh Lian Lim, MD,[#] Holly Murphy, MD,[**] Jay Keystone, MD,[††] Jacob Cramer, MD,[‡‡] Marc Shaw, MD, PhD,[§§‖‖] Jacques Boddaert, MD, PhD,[¶¶] Frank von Sonnenburg, MD, PhD,[##] and Philippe Parola, MD, PhD[*] for the GeoSentinel Surveillance Network [***]

[*]Infectious Diseases and Tropical Medicine Unit, North University Hospital, AP-HM, Marseille, France; [†]Equipe Biostatistiques, LERTIM, Faculté de Médecine, Marseille, France; [‡]Department of Epidemiology and Preventive Medicine, Monash University, Victoria, Australia; [§]Victorian Infectious Disease Service, Royal Melbourne Hospital, Parkville, Victoria, Australia; [‖]Center for Geographical Medicine, Chaim Sheba Medical Center, Tel Hashomer, Israel; [¶]Institute for Infectious and Tropical Disease, University of Brescia, Brescia, Italy; [#]Department of Infectious Diseases, Tan Tock Seng Hospital, Singapore, Singapore; [**]CIWEC Clinic Travel Medicine Center, Kathmandu, Nepal; [††]Tropical Disease Unit, Toronto General Hospital, Toronto, Canada; [‡‡]Department of Tropical Medicine and Infectious Diseases, Bernhard-Nocht-Institute for Tropical Medicine, Hamburg, Germany; [§§]Worldwise Travellers Health and Vaccination Centre, Auckland, New Zealand; [‖‖]James Cook University, Townsville, Queensland, Australia; [¶¶]Geriatric Department and Emergency Department, Inserm U-970, Pitié-Salpêtrière University Hospital, AP-HP, Paris, France; [##]Department of Infectious Diseases and Tropical Medicine, LMU University of Munich, Munich, Germany; [***]See Appendix 1 for members of the GeoSentinel Surveillance Network

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Background. Older individuals represent a substantial proportion of international travelers. Because of physiological changes and the increased probability of underlying medical conditions, older travelers might be at higher risk for at least some travel-associated diseases.

Methods. With the aim of describing the epidemiology of travel-associated diseases in older adults, medical data were prospectively collected on ill international travelers presenting to GeoSentinel sites from 1997 to 2009. Seven thousand thirty-four patients aged 60 years and over were identified as older travelers and were compared to 56,042 patients aged 18–45 years, who were used as the young adult reference population.

Results. The proportionate morbidity of several etiological diagnoses was higher in older ill travelers compared to younger ill, including notably lower respiratory tract infections, high-altitude pulmonary edema, phlebitis and pulmonary embolism, arthropod bites, severe malaria, rickettsiosis, gastritis, peptic ulcers, esophagitis and gastroesophageal reflux disease, trauma and injuries, urinary tract infections, heart disease, and death. In contrast, acute diarrhea, upper respiratory tract infections, flu and flu-like illnesses, malaria, dengue, genital infections, sexually transmitted diseases, and schistosomiasis proportionate morbidities were lower among the older group.

Conclusion. Older ill travelers are more likely to suffer from certain life-threatening diseases and would benefit from reinforcement of specific preventive measures including use of anti-thrombosis compression stockings and sufficient hydration and exercises during long-distance flights, hand hygiene, use of disposable handkerchiefs, consideration of face-masks in crowded conditions, influenza and pneumococcal vaccines, progressive acclimatization to altitude, consideration of acetazolamide, and use of repellents and mosquito nets. Antibiotics for the presumptive treatment of respiratory and urinary tract infections may be considered, as well as antacid medications. At-risk patients should be referred to a specialist for medical evaluation before departing, and optimal control of co-morbidities such as cardiovascular and chronic obstructive pulmonary diseases should be achieved, particularly for high-altitude travel.

Older individuals represent a substantial proportion of international travelers, with an estimated 15–30% of travelers being aged 60 years or older;[1–3] this proportion is increasing over time.[4] In a study of 1,416 US travelers attending a pre-travel clinic, 48% were >50 years of age, one third were >60 years, and almost 1.5% were >80 years of age.[2] Because of their greater difficulty in acclimatizing during travel, adjusting to extreme climatic conditions (temperature, humidity, and altitude), their greater predisposition for contracting certain diseases, their increased probability of underlying medical conditions,

Corresponding Author: Philippe Gautret, MD, PhD, Service des Maladies Infectieuses et Tropicales, Hôpital Nord, AP-HM, F-13015 Marseille, France. E-mail: philippe.gautret@club-internet.fr

waning immunity from vaccines previously received, and reduced responses to vaccines provided at pre-travel consultations, including those against hepatitis A, hepatitis B, and rabies,[5] as well as "routine" vaccines such as influenza[6] and pneumococcal infections,[7] older travelers might be at a higher risk for at least some travel-associated diseases.[8,9] The premiums of travel health insurance for people over 60 years of age are often a lot higher than those for younger people because of an increased proportion of claims, costly air medical evacuations,[10] and death abroad in the older group.[11] However, the epidemiology of travel-associated diseases in older adults, including chronic disease exacerbation, is not well described with the exception of traveler's diarrhea and considerable health advice written for older travelers is based on data taken from the entire older (non-traveling) population.[9] There are wide physiological differences between younger and older people,[12] although the population of older travelers may be somewhat distinct from the general older population, as the truly frail elderly probably do not frequently undertake international travel.

No study has been published that addresses the spectrum of illnesses among older individuals traveling to a broad range of destinations. In this context, we analyzed diagnoses with demographic, clinical, and travel-related predictors of disease among older ill travelers who presented to GeoSentinel clinics between 1997 and 2009, including a large proportion of individuals returning from tropical countries.

Patients and Methods

Data Source

Data were prospectively collected on patients presenting to GeoSentinel sites from March 1997 to August 2009. The GeoSentinel Surveillance Network (http://www.istm.org/geosentinel/main.html) consists of specialized travel/tropical medicine clinics on six continents, where ill travelers are seen during or after traveling to a wide range of countries and where information on travelers is prospectively recorded using a standardized format.[13] To be eligible for inclusion in the GeoSentinel database, patients must have crossed an international border and sought medical advice at a GeoSentinel clinic for a presumed travel-related illness or have been diagnosed with a disease related to a travel history by the physician. Data collected included: demographic information, travel data, reason for most recent travel, inpatient or outpatient status, history of a pre-travel clinic visit, and travel-related clinical findings. Chronic conditions and co-morbidities are not documented in the GeoSentinel database. Reasons for travel were classified as: tourism, business, research/education, missionary/volunteer work, military, medical tourism, or visiting friends and relatives. Patients whose reason for travel was to immigrate were excluded. Individual countries visited were grouped into eight regions (Table 1). The place of exposure was defined by the clinician if he/she had confidence that the illness was acquired in that place given the duration of the incubation period and/or known endemicity patterns or if the region was the only one visited by the patient. Medical data included the final physician-assigned diagnoses according to a standardized list of 556 possible etiological diagnoses of diseases, including death that were also categorized under 21 broad syndromes, as previously described.[13] When necessary, several final diagnoses were assigned to one patient. The travel duration, a proxy for duration of exposure, was measured as the duration of the most recent travel. The time to presentation was calculated as the time between the end of travel and presentation at a GeoSentinel clinic. These two variables were evaluated for travelers seen after travel only.

Statistical Analysis

Patients aged 60 years and over were identified as older travelers with an age limit based on that used by many travel insurance providers to define an older person and were compared to patients aged 18–45 years as a young adult reference population. Patients aged 46–59 years were not included so that the comparison group of adult travelers would have the greatest probability of differing from travelers >60 years, in term of physiological status and behavior during travel. Age groups were defined prior to the statistical analysis. Data were entered into and managed in Microsoft Access (Microsoft Corp., Redmond, WA, USA). In our evaluation, proportionate morbidity refers to the number of cases of a specific diagnosis (or of a group of specific diagnoses within a syndrome group) compared with all cases of ill travelers (excluding cases with the specific diagnosis being investigated) of the same age group that were seen at GeoSentinel clinics during the same period. Thus, the proportionate morbidity is not an acquisition incidence rate of travel-related illness and cannot infer absolute risk. Differences in the proportions (categorical variables) were tested using Fisher exact tests, and Kruskal–Wallis tests were used for continuous variables. p Values <0.05 were considered significant. Odds ratios (ORs) (older travelers vs young adult travelers) by diagnosis were estimated by logistic regression and adjusted for travel reason, sex, pre-travel advice, region of exposure, and clinical setting. The Mantel–Haenszel statistic was used to test for diagnosis trends by age classes. All statistical tests were two-sided. Percentages and ORs (with 95% confidence intervals), comparisons, and graphic analyses were carried out using the R 2.8.1 environment (www.r-project.org).[14]

Results

A total of 89,521 ill travelers recorded in the GeoSentinel database during the study period. A total of 63,076 ill adult travelers were included in the

Table 1 Demographic and travel data of 63,076 ill travelers seen in GeoSentinel clinics between 1997 and 2008

Age classes	18–45 y	≥60 y	*p*-Value*
Number of patients	56,042	7,034	
Sex			<0.001
Female	28,571 (51.0%)	3,174 (45.1%)	
Male	27,180 (48.5%)	3,833 (54.5%)	
Unknown	291 (0.5%)	27 (0.4%)	
Region of residence (expatriates excluded)			<0.001
Asia	3,850 (7.9%)	445 (6.7%)	
Africa	469 (1.0%)	56 (0.8%)	
Latin America	287 (0.6%)	38 (0.6%)	
Europe (West and East)	24,391 (50.9%)	3,257 (49.1%)	
Middle East	3,273 (6.8%)	215 (3.2%)	
North America-Canada	12,885 (26.9%)	2,413 (36.4%)	
Oceania	14 (0.0%)	2 (0.0%)	
Australia-New Zealand	2,707 (5.6%)	209 (3.1%)	
Reason for travel			<0.001
Tourism	30,079 (53.7%)	4,666 (66.3%)	
Business	13,119 (23.4%)	1,173 (16.7%)	
Missionary/volunteer/research/aid work†	7,431 (13.3%)	599 (8.5%)	
Visiting friends and relatives	3,902 (7.0%)	563 (8.0%)	
Student‡	1,306 (2.3%)	8 (0.1%)	
Military	157 (0.3%)	8 (0.1%)	
Medical tourism	48 (0.1%)	17 (0.2%)	
Median travel duration [d (first to third quartiles)]	28 (14–86)	21 (14–42)	<0.001
Risk level qualifier§ <0.001			
Expatriate	10,733 (19.2%)	782 (11.1%)	
Pre-arranged or organized trip	7,289 (13.0%)	1,384 (19.7%)	
Risk travel	13,437 (24.0%)	1,816 (25.8%)	
Unknown	24,583 (43.9%)	3,052 (43.4%)	
Pre-travel advice			<0.001
Yes	28,999 (51.7%)	2,971 (42.2%)	
No	16,834 (30.0%)	2,496 (35.5%)	
Unknown	10,209 (18.2%)	1,567 (22.3%)	
Clinical setting†			<0.001
Seen after travel	36,936 (65.9%)	4,981 (70.8%)	
Seen during travel	19,101 (34.1%)	2,053 (29.2%)	
Unknown	5 (0.0%)	–	
Patient type			0.54
Outpatient	49,261 (87.9%)	6,177 (87.8%)	
Inpatient	6,086 (10.9%)	782 (11.1%)	
Unknown	695 (1.2%)	75 (1.1%)	
Mean time to presentation (d)	13	15	<0.001
Region of travel			<0.001
Asia	30,459 (54.4%)	3,311 (47.1%)	
Africa	12,146 (21.7%)	1,543 (21.9%)	
Latin America	8,761 (15.6%)	1,161 (16.5%)	
Europe (West and East)	2,300 (4.1%)	542 (7.7%)	
Middle East	796 (1.4%)	179 (2.5%)	
North America-Canada	767 (1.4%)	171 (2.4%)	
Oceania	440 (0.8%)	70 (1.0%)	
Australia-New Zealand	373 (0.7%)	57 (0.8%)	

Travel duration and time to presentation were calculated for travelers seen after travel only.

*Unknown data were excluded from statistical analysis.

†Travel for missionary, volunteer, aid work, or research.

‡Travel to be a full-time student in a recognized educational institution or travel as part of a group trip under the sponsorship of a recognized educational institution, and for which the primary purpose is study or a non-research educational activity. Not used for those traveling for other reasons who happen to be students.

§Expatriate—intended to identify individuals living in the destination country with an independent residence and address and using mostly the infrastructures used by local residents of the same economic class. Independent of duration of residence. Expatriates in developing countries characterize those who eat mostly at home and use their own transportation but will intermittently encounter risks (food, vectors, and sleeping conditions) faced by the local population. Pre-arranged and organized trip—intended to identify travelers who are sheltered or "cocooned" from many of the risks (food, vectors, and sleeping conditions) faced by the local population, use the infrastructure of the travel industry (including internet self-booking) in the home country for most of the arrangements, use standard or better hotel or other short-stay temporary accommodations, eat mostly at restaurants that serve large numbers of foreigners and that are often pre-screened by tour operators or employers, and use mostly in-country transportation specifically serving tourists or foreigners. Risk travel—intended to identify travelers who will, by their behavior, encounter a substantial number of the risks facing the local population. This classification would generally include no pre-booking of accommodations for most or all nights and/or use of the accommodations specific to budget travelers or those staying in the houses of local residents.

study of which 7,034 were aged 60 years and over, accounting for 8.4% of the whole population seen at GeoSentinel clinics during the study period. The mean age was 66 years in the older group (median: 65, range 60–98 y) and 31 years in the adult reference group (median: 30, range 18–45 y). A total of 1,532 ill travelers were aged 70 years and over, accounting for 22% of the older group. Demographic and travel data showed several statistically significant differences according to age (Table 1). Compared to younger patients, older patients presenting to GeoSentinel sites were more likely to be male, to be resident in North America and Canada and to travel for tourism; there were fewer business travelers in the older group. The median travel duration was shorter in the older traveler group. The proportion of individuals traveling in pre-arranged or organized trips was higher among older patients compared to younger patients, but the proportion of those who had sought travel advice was lower among the older group. The travel region differed among age groups, with Europe, the Middle East, and North America being more frequently visited among older individuals. The proportionate morbidity of broad syndromes also differed between older and younger travelers (Table 2). Acute diarrhea was the most common complaint in both groups of ill travelers, although comparatively it was significantly less frequent in the older group. While febrile systemic illness was the second most common complaint in the younger group, respiratory disease ranked as the second most frequent reason for presentation to a GeoSentinel site in the older group. Among other syndromes, non-diarrheal gastrointestinal disease, musculoskeletal disorders, neurological, genitourinary, and cardiovascular-related morbidity were comparatively higher in the older group, as were chronic diseases. Further analysis of diseases in the older group showed that the proportionate morbidity of some broad syndromes was higher in patients traveling to specific regions, notably acute diarrhea in Asia, the Middle East, Africa, and Latin America; respiratory syndromes in North America and Europe; and febrile systemic illness in Africa and Oceania (Table 2). The distribution of single etiological diagnoses differed significantly between older and younger travelers, as shown in Table 3. Lower respiratory tract infections (LRTIs), high-altitude pulmonary edema (HAPE), arthropod bites, *Plasmodium falciparum* severe malaria, rickettsiosis, gastritis, peptic ulcer, esophagitis and gastroesophageal reflux disease (GERD), strongyloïdes, trauma and injuries, altitude illness, vertigo, cerebrovascular accident, urinary tract infections (UTIs), heart disease, phlebitis, pulmonary embolism, and death were more frequently observed in older GeoSentinel patients compared to their younger counterparts. Deaths in young and older travelers were mainly caused by infectious diseases. In contrast, acute bacterial and parasitic diarrhea, upper respiratory tract infections (URTI), flu and flu-like illnesses, larva migrans, dengue, non-severe *P falciparum* and non-*P falciparum* malaria, salmonella infections, genital infections and sexually transmitted diseases, and schistosomiasis were comparatively less frequently diagnosed in the older group. Illnesses observed in more than 45 patients per age group were further investigated

Table 2 Syndrome groups according to age group and region of exposure (number of cases per 100 ill travelers) of 63,076 ill travelers seen in GeoSentinel clinics between 1997 and 2008

All destinations				Region of exposure (patients 60 y and over only)								
Syndrome	18–45 y	≥60 y	*p*-Value	Asia	Australia/ New Zealand	Europe	Middle East	North America	Africa	Oceania	Latin America	*p*-Value
Number of patients	56,042	7,034		3,311	57	542	179	171	1,543	70	1,161	
Acute diarrhea	22.9	16.7	<0.001	19.7	5.3	11.6	16.8	7.0	15.0	11.4	15.2	<0.001
Respiratory	10.3	14.6	<0.001	18.5	19.3	21.0	15.6	26.9	7.9	10.0	7.1	<0.001
Dermatologic	13.3	14.5	0.004	12.7	19.3	15.1	17.9	13.5	14.8	14.3	18.8	<0.001
Febrile systemic illness	18.3	12.6	<0.001	8.6	8.8	9.2	10.6	12.9	22.5	28.6	12.1	<0.001
Other gastrointestinal	6.1	7.6	<0.001	6.7	10.5	11.8	9.5	7.6	5.2	2.9	10.9	<0.001
Musculoskeletal	3.9	6.5	<0.001	9.9	12.3	6.8	1.7	7.0	2.4	1.4	2.9	<0.001
Chronic diarrhea	6.5	5.9	0.045	3.7	10.5	5.5	7.8	5.3	7.0	5.7	10.2	<0.001
Neurologic	2.2	3.6	<0.001	4.7	5.3	3.5	1.7	3.5	2.3	4.3	2.5	<0.001
GU and STD	2.8	3.5	0.001	4.5	1.8	5.4	0.6	3.5	2.9	–	1.6	<0.001
Chronic disease	1.8	3.4	<0.001	3.1	1.8	5.9	4.5	5.8	2.9	5.7	3.4	0.016
Cardiovascular	0.5	3.4	<0.001	4.2	7.0	6.8	0.6	7.6	1.4	1.4	2.1	<0.001
Psychological	2.1	1.5	0.001	1.4	5.3	2.2	1.1	3.5	1.2	4.3	1.4	0.021
Oral and dental	2.0	1.1	<0.001	1.6	–	0.9	1.1	1.2	0.6	–	0.5	0.018
Tissue parasite	0.9	1.0	0.34	0.4	–	0.6	0.6	–	2.9	1.4	0.7	<0.001
Ophthalmologic	0.6	0.7	0.33	1.2	–	0.4	1.1	–	0.1	0.0	0.3	<0.001
Obstetric/gynecologic*	2.3	0.3	<0.001	0.4	–	–	–	–	0.1	–	0.7	0.61

–= no case; GU = genitourinary transmitted diseases; STD = sexually transmitted diseases.
*Per 100 ill female patients.

Table 3 Selected etiological diagnoses according to age group (number of cases per 100 ill travelers) of 63,076 ill travelers seen in GeoSentinel clinics between 1997 and 2008

Diagnosis (total number of cases)	18–45 y	≥60 y	*p* Value
Number of patients	56,042	7,034	
Acute diarrhea, bacterial (6,483)	11.2	7.3	<0.001
Acute diarrhea, parasitic (3,125)	5.4	3.5	<0.001
Upper respiratory tract infections (4,106)	7.0	5.3	<0.001
Lower respiratory tract infections (1,967)	2.8	7.3	<0.001
Influenza and flu-like illness (674)	1.2	0.8	0.003
High-altitude pulmonary edema (271)	0.4	1.1	<0.001
Skin infections, bacterial (1,559)	2.6	2.7	0.60
Arthropod bite (1,428)	2.2	3.6	<0.001
Potentially rabid animal-related injuries (1,099)	1.8	1.8	0.96
Larva migrans (669)	1.2	0.5	<0.001
Cutaneous and muco-cutaneous leishmaniasis (253)	0.4	0.5	0.62
Myiasis (187)	0.3	0.3	0.72
Dengue (2,232)	4.0	1.4	<0.001
Plasmodium falciparum malaria—all cases (1,567)	2.7	1.8	<0.001
Plasmodium falciparum malaria—severe and complicated (77)	0.1	0.3	<0.001
Non-*P falciparum* malaria (910)	1.6	0.9	<0.001
Salmonella infection (704)	1.3	0.5	<0.001
Rickettsial infection (272)	0.4	0.7	0.007
Chikungunya (135)	0.2	0.3	0.17
Gastritis, peptic ulcer, esophagitis, and GERD (623)	1.0	1.6	<0.001
Viral hepatitis* (600)	1.0	1.1	0.27
Strongyloïdes (355)	0.5	1.1	<0.001
Trauma and injuries (1,311)	2.1	3.2	<0.001
Altitude illness (neurological)† (403)	0.6	1.2	<0.001
Meningitis and encephalitis (211)	0.3	0.4	0.19
Mefloquine intolerance (154)	0.3	0.2	0.89
Vertigo (104)	0.2	0.3	0.003
Cerebrovascular accident (40)	0.0	0.5	<0.001
Urinary tract infections (979)	1.6	2.2	<0.001
Genital infections and STD (748)	1.3	0.7	<0.001
Kidney stone (77)	0.1	0.2	0.14
Heart disease (147)	0.1	1.5	<0.001
Phlebitis and pulmonary embolism (99)	0.1	0.4	<0.001
Schistosomiasis (580)	1.0	0.7	0.019
Death (39)‡	0.0	0.2	<0.001
Vaccine side effects (12)	0.0	–	0.38

GERD = gastroesophageal reflux disease; STD = sexually transmitted disease.
*Viral hepatitis: acute hepatitis A, B, C, and unspecified, chronic hepatitis B and C, asymptomatic hepatitis B carrier, and hepatitis D and E (each type of hepatitis was also compared separately between older and younger travelers and no significant differences were evidenced).
†Altitude illness (neurological): high-altitude cerebral edema and acute mountain sickness.
‡Death: 18–45 y (45 per 10^5): malaria (1), dengue (2), encephalitis (3), angiostrongyloidiasis (1), rickettsial infection (2), Epstein Barr Virus (1), respiratory infection (2), influenza (1), gastrointestinal infection (2), *Salmonella typhi* (1), acquired immune-deficiency syndrome (1), trauma (4), cardiac (3), and autoimmune disorder (1) and >60 y (199 per 10^5): malaria (3), pneumonia (4), pneumococcal meningitis (1), pyelonephritis (2), gastrointestinal infection (1), rabies (1), pulmonary embolism (1), and trauma (1).

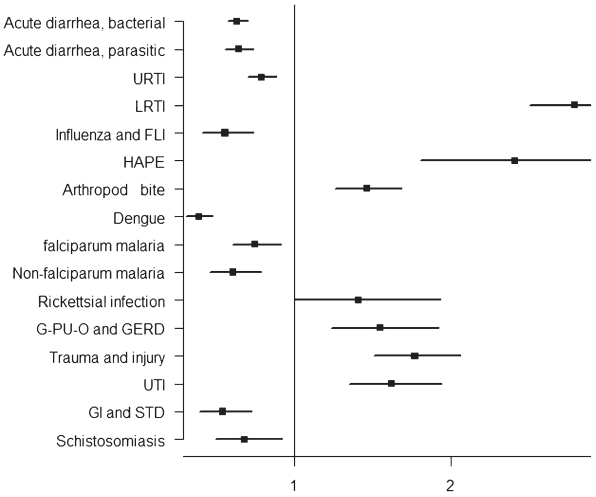

Figure 1 Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for diagnosis profiles for travelers aged 60 years and over versus travelers aged 18–45 years of 63,076 ill travelers seen in GeoSentinel clinics between 1997 and 2008. Only significant ORs are presented. Only diagnoses including at least 45 cases by age group are presented. Diagnosis profiles are adjusted for sex, reason for travel, clinical settings, pre-travel advice, and region of exposure. URTI = upper respiratory tract infection; LRTI = lower respiratory tract infection; FLI = flu-like illness; HAPE = high-altitude pulmonary edema; *P falciparum* malaria = all cases including complicated malaria; G-PU-O = gastritis, peptic ulcer, and esophagitis; GERD = gastroesophageal reflux disease; UTI = urinary tract infection; GI = genital infection; and STD = sexually transmitted disease. Heart disease (OR 15.88, CI 11.17–22.87) was not included in the figure due to the magnitude of the OR.

for potential confounders such as sex, reason for travel, travel duration and region of travel, pre-travel advice, clinical settings, and risk level qualifier. We found that age per se was associated with the distinct patterns of travel-associated illness observed in older and younger individuals in all cases with the exception of high-altitude cerebral edema, acute mountain sickness, and strongyloïdes (Figure 1). Subanalysis in the older group by age category showed a linear positive relationship between age and the relative proportion of death, heart disease, and LRTI, and an inverse relationship between age and *P falciparum* malaria and dengue among ill travelers, with all trends being significant ($p < 0.001$) (Figure 2).

Discussion

Among ill adult travelers seen at GeoSentinel clinics, individuals over 60 years of age represent a substantial proportion of patients, and it is of significant interest that 22% of older ill travelers in our cohort were over 70 years of age. This suggests that the elderly might represent an important proportion of individuals seeking information on travel-related diseases and that

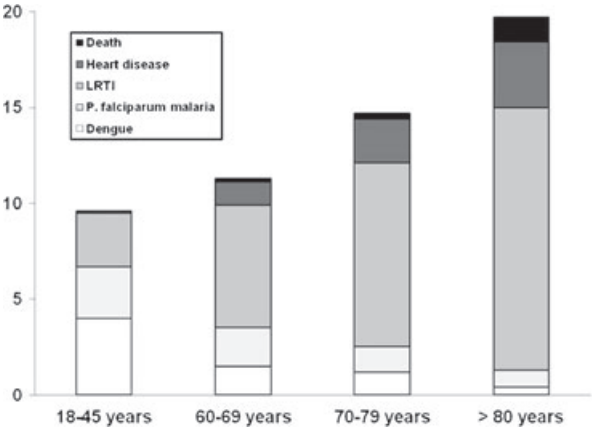

Figure 2 Age dependence of selected travel-associated diseases (number of cases per 100 ill travelers) of 63,076 ill travelers seen in GeoSentinel clinics between 1997 and 2008. LRTI = lower respiratory tract infection; *P falciparum* malaria = all cases including complicated malaria. Only significant trends are presented.

targeted pre-travel advice based on reliable data should be provided. We observed that older ill travelers returning to GeoSentinel sites conducted short-term, pre-arranged, and organized tourism trips more frequently, traveled more frequently to Europe and the United States, and consequently sought pre-travel advice less frequently than their younger counterparts. This lower proportion who sought pre-travel advice may also possibly reflect that they were more often experienced travelers. While ideally all travelers should be encouraged to receive a pre-travel medical evaluation, tour operators should particularly encourage this for their older travelers, and should encourage this to occur in a timely manner.

In our study, the spectrum of illness differed significantly based on the age of ill travelers after eliminating confounding factors including travel destination. As expected, the proportionate morbidity of age-associated conditions was significantly higher in the older group. This observation confirms that travel health advisors or general practitioners who counsel older individuals at pre-travel consultations have to consider their pre-travel health status and anticipate potential exacerbations, in particular by minimizing venous thromboembolism during travel through recommendation of the use of anti-thrombosis compression stockings, sufficient hydration and exercises during long-distance flights, and by optimizing control of cardiovascular diseases and referring at-risk patients to a cardiologist for medical evaluation before departure.

Acute diarrhea was shown to be a comparatively less frequent reason for presentation in older travelers regardless of the responsible pathogen, and a lower proportionate morbidity of diarrhea in older travelers was found even after controlling for gender and travel conditions (region, reason for travel, and pre-travel advice). While this does not infer that the absolute risk of acute diarrhea is lower in the elderly, other studies support this finding.[15,16] This may suggest that the protection conferred by age is related to an increased likelihood of past exposure to pathogens,[17] or alternatively that there may be better adherence by older individuals to reducing risky dietary exposures.[18] No significant age-related difference in the proportion of patients suffering from chronic diarrhea was observed in our study.

While presenting comparatively less frequently with URTI, older travelers had a greater proportionate morbidity from LRTI, including pneumonia and bronchitis. This finding has been previously reported among GeoSentinel patients.[19] The GeoSentinel database do not contain data on smokers or chronic obstructive pulmonary disease (COPD); however, these factors may have played a role as epidemiologically they are more frequent in patients over the age of 60. Our results suggest that older travelers should be targeted for preventive measures against respiratory infections, including hand hygiene, use of disposable handkerchiefs, and consideration of face-masks in crowded conditions. Optimization of COPD management should also be considered for older patients prior to travel. Influenza was the most frequent vaccine-preventable disease observed in our study. Although the proportion of GeoSentinel patients who received an influenza vaccination is unknown, putative greater vaccination rates in the elderly may have accounted for the higher proportion of influenza observed among younger travelers. This finding nevertheless supports the need for the vaccination of all travelers against influenza regardless of age. Pneumococcal vaccines would also benefit older travelers based on the higher proportion of individuals >60 years of age that presented with LRTI.[20]

We observed that HAPE proportionate morbidity was higher in older than younger ill travelers. Also, the proportion of lower respiratory infections in travelers suffering HAPE was only 12% in older individuals and 17% in the younger group in our study. While several earlier investigations in Nepal and elsewhere concluded that older age might be protective against altitude illness,[21–23] recent studies challenge these conclusions.[24,25] We conclude that older travelers to high-altitude destinations presented to GeoSentinel clinics comparatively more frequently than younger travelers, and that these data were not attributable to concomitant respiratory infection. We propose that older travelers have pre-travel cardiologic assessment for high-altitude travel and strictly apply prevention measures when undergoing a high-altitude trip by progressive acclimatization to altitude and use of acetazolamide.

While mosquito bites were more frequently reported in older travelers, febrile, systemic mosquito-borne illnesses like malaria and dengue were less frequent reasons for presentation in older ill travelers. We have no explanation for this paradoxical finding. Severe *P falciparum* malaria, however, was comparatively more

frequent in the older group, which has been observed by others.[26–28] As shown in a previous GeoSentinel study, older age appeared to correlate with a higher proportionate morbidity from rickettsial infections, mainly due to spotted fever-group rickettsia.[29] It has been suggested that an increased likelihood of spotted fever-group rickettsiae may be related to the increased disposable income and leisure time required for African safari itineraries.[30] Although African tick-bite fever is usually benign and self-limited, it may lead to more severe complications in older travelers.[31] Prevention of arthropod bites using repellents and mosquito nets and malaria chemoprophylaxis should be reinforced regardless of age.

While the lower likelihood for older travelers to present with cutaneous larva migrans and schistosomiasis may not correlate with lower absolute risks of these infections, it is nevertheless possible that this finding results from a stronger adherence by older individuals to avoiding contact with wet soil and fresh water, thus less frequently engaging in at-risk activities.

Finally, the higher likelihood of travel-associated UTI, gastritis, peptic ulcer, and GERD suggests that these diseases should also be considered in older travelers receiving pre-travel advice. Antibiotics for the presumptive treatment of respiratory and UTIs may be considered, as well as antacid medications although the latter may possibly increase the risk of traveler's diarrhea.

We also found that the relative frequency of trauma and injuries in travelers increased with advancing age, which may result from age-related decreased sensory, motor, and perceptual skills.

Deaths were four times more frequent in the older group compared to the younger one and mainly caused by infectious diseases which reflects the predominance of specialized infectious diseases clinics in GeoSentinel network, when deaths in travelers are usually caused by trauma and non-communicable diseases.[11]

The major strength of our analysis is its multicenter nature, which provided a large number of participants from many countries and captured all traveler types, and its focus on proportionate morbidity. The limitations of this method of analysis have been recently discussed.[32] In particular, because the denominator data (number of travelers) cannot be ascertained, it is not possible to calculate incidence rates or absolute risk. Also, this data might not be representative of the overall population of travelers, and the results do not represent the broad spectrum of illnesses typically seen at non-specialized primary care practices where mild or self-limited conditions present with higher frequency. Due to the nature of GeoSentinel clinics, illnesses acquired after travel to non-tropical destinations or non-infectious travel-related illnesses may be underrepresented. Underlying chronic diseases are not documented by GeoSentinel which does not allow evaluation of their influence on travel-associated morbidity. However, the GeoSentinel database (and associated analyses) has nevertheless been identified as a valuable source of data on the epidemiology of travel-related illnesses.[13,32,33]

In conclusion, older travelers represent a minority of patients in travel clinics but they are usually sicker with a higher relative proportion of life-threatening diseases (LRTI, HAPE, severe *P falciparum* malaria, cardiovascular disease, and pulmonary embolism),[34] as well as a higher proportion of death, compared to younger patients. Older travelers should be specifically targeted for the prevention of such diseases and advised to obtain travel insurance that covers chronic stable medical conditions, acute illnesses, accidents, evacuation, and death.

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Declaration of Interests

The authors state they have no conflicts of interest to declare.

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Appendix 1

Members of the GeoSentinel Surveillance Network

In addition to the authors, members of the GeoSentinel Surveillance Network who contributed data (in descending order) are as follows: Prativa Pandey, CIWEC Clinic Travel Medicine Center, Kathmandu, Nepal; Kevin C. Kain, University of Toronto, Toronto, Canada; Gerd-Dieter Burchard, Bernhard-Nocht-Institute for Tropical Medicine, Hamburg, Germany; Michael D. Libman, Brian Ward, and J. Dick Maclean, McGill University, Montreal, Canada; Anne McCarthy, University of Ottawa, Ottawa, Canada; Bradley A. Connor, Cornell University, New York City, New York, USA; Fabrice Simon and Jean Delmont, Hôpital Nord, Marseille, France; Louis Loutan and François Chappuis, University of Geneva, Geneva, Switzerland; Vanessa Field, InterHealth, London, United Kingdom; Andy Wang and Susan MacDonald, Beijing United Family Hospital and Clinics, Beijing, Peoples Republic of China; Mogens Jensenius, Oslo University Hospital, Oslo, Norway; DeVon C. Hale and Stephanie S. Gelman, University of Utah, Salt Lake City, Utah, USA; Patricia Schlagenhauf, Rainer Weber, and Robert Steffen, University of Zürich, Zürich, Switzerland; Eric Caumes and Alice Pérignon, Hôpital Pitié-Salpêtrière, Paris, France; Nicole Anderson, Trish Batchelor, and Dominique Meisch, International SOS Clinic, Ho Chi Minh City, Vietnam; Giampiero Carosi, University of Brescia, Brescia, Italy; William M. Stauffer and Patricia F. Walker, University of Minnesota, Minneapolis, Minnesota, USA; Annelies Wilder-Smith, Tan Tock Seng Hospital, Singapore; Carmelo Licitra and Antonio Crespo, Orlando Regional Health Center, Orlando, Florida, USA; Joseph Torresi and Graham Brown, Royal Melbourne Hospital, Melbourne, Australia; Natsuo Tachikawa, Hanako Kurai, and Hiroko Sagara, Yokohama Municipal Citizen's Hospital, Yokohama, Japan; Christina M. Coyle and Murray Wittner, Albert Einstein School

of Medicine, New York City, New York, USA; Phyllis E. Kozarsky and Carlos Franco-Paredes, Emory University, Atlanta, Georgia, USA; Michael W. Lynch, Fresno International Travel Medical Center, Fresno, California, USA; N. Jean Haulman, David Roesel, and Elaine C. Jong, University of Washington, Seattle, Washington, USA; Sarah Borwein, Central Health Medical Practice, Honk Kong SAR, China; Peter J. de Vries and Kartini Gadroen, University of Amsterdam, Amsterdam, The Netherlands; Thomas B. Nutman and Amy D. Klion, National Institutes of Health, Bethesda, Maryland, USA; Effrossyni Gkrania-Klotsas, Addenbrooke's Hospital, Cambridge, United Kingdom; Lin H. Chen and Mary E. Wilson, Mount Auburn Hospital and Harvard School of Public Health, Harvard University, Cambridge, Massachusetts, USA; Shuzo Kanagawa and Yasuyuki Kato, International Medical Center of Japan, Tokyo, Japan; David O. Freedman, University of Alabama at Birmingham, Birmingham, Alabama, USA; Annemarie Hern, Worldwise Travellers Health and Vaccination Centre, Auckland, New Zealand; Vernon Ansdell, Kaiser Permanente, Honolulu, Hawaii, USA; Alejandra Gurtman, Mount Sinai Medical Center, New York City, New York, USA (October 2002 to August 2005 only); Rogelio López-Vélez and Jose Antonio Perez Molina, Hospital Ramon y Cajal, Madrid, Spain; Luis Valdez and Hugo Siu, Clinica Anglo Americana, Lima, Peru; John D. Cahill and George McKinley, St. Luke's-Roosevelt Hospital Center, New York City, New York, USA; Noreen Hynes, R. Bradley Sack, and Robin McKenzie, Johns Hopkins University, Baltimore, Maryland, USA; Cecilia Perret and Francisca Valdivieso, Pontificia Universidad Católica de Chile, Santiago, Chile; Watcharapong Piyaphanee and Udomsak Silachamroon, Mahidol University, Bangkok, Thailand; Marc Mendelson and Peter Vincent, University of Cape Town and Tokai Medicross Travel Clinic, Cape Town, South Africa; Robert Muller, Travel Clinic Services, Johannesburg, South Africa (May 2004 to June 2005 only); Susan McLellan, Tulane University, New Orleans, Louisiana, USA (December 1999 to August 2005 only); Stefan Hagmann and Andy O. Miller, Bronx-Lebanon Hospital Center, New York City, New York, USA; Robert Kass, Travellers Medical and Vaccination Centres of Australia, Adelaide, Australia (December 1997 to March 2001 only); Patrick Doyle and Wayne Ghesquiere, Vancouver General Hospital, Vancouver, British Columbia, Canada; Elizabeth D. Barnett, Boston University, Boston, Massachusetts, USA; Paul Holtom, Jeff Goad, and Anne Anglim, University of Southern California, Los Angeles, California, USA; Nancy Piper Jenks and Christine Kerr, Hudson River Health Care, Peekskill, New York, USA; and Jose Flores-Figueroa and Pablo C. Okhuysen, Travel Medicine Research Clinic, Cuernavaca, Morelos, Mexico.